SERVICE MANUAL

FOR THE

RME 69 RECEIVER

PRICE 25¢

RADIO MFG. ENGINEERS, INC.
300-306 First Avenue
Peoria 6, Illinois

SERVICE NOTES FOR THE RME-69 RECEIVER

ALIGNMENT

One of the first evidences of misalignment in a receiver is low over-all gain of the receiver. In the RME-69 Receiver this is evidenced by low meter readings on signals which were formerly capable of producing higher meter readings. Due to the tremendous gain available in the audio system of the RME-69 Receiver, a misalignment due to loss of gain may not be noticed if the condition of the receiver is judged by audio output, since it may be possible to turn the volume control to the maximum output position and still obtain high values of audio output. Misalignment, however, does not effect the circuits of the audio amplifier and has solely to do with the intermediate frequency amplifier and, to some extent, the radio frequency amplifiers. Principal among the contributions to low gain is the part which the intermediate frequency amplifier plays in providing over-all sensitivity and selectivity of a satisfactory order.

Misalignment of the radio frequency section (principally that part of the section which is made up of the high frequency oscillator) is the control of the receiver calibration. This also is susceptible to certain outside influences which can cause variations to such a degree that the stated calibration of the receiver is changed to other values. However, this effect is not common and usually the calibration of the receiver, unless tampered with by inexperienced hands, will remain very close to its stated value indefinitely.

This loss of gain when occurring in the radio frequency section of the receiver is usually due to the fact that the oscillator has been grossly misaligned so that it is apparent in the frequency calibration of the receiver. In other words, it might well be said that a loss of sensitivity in the receiver occurring simultaneously with a wide-spread condition of off calibration might indicate the fact that the loss of gain is caused by misalignment of the radio frequency section of the receiver.

On the other hand, if the gain of the receiver is low, but the calibration is correct, it might be said without hesitation that the most probable cause for the low gain is the misalignment of the intermediate frequency amplifiers relative to the trimming condensers of the intermediate frequency amplifier transformers.

It is for the purpose of realignment of these intermediate frequency transformers that the following test procedure is outlined:

> IMPORTANT NOTE: It is essential that the 465 KC intermediate signal which is used for realignment of the intermediate frequency amplifier is not set according to any arbitrary calibration on the test oscillator itself, since it has been found that commercial test oscillators for service work vary considerably, at least to an extent which will not permit proper alignment of a communication type receiver in which a quartz crystal is installed. It is therefore better if no test oscillator is had, since a broadcast station of constant signal strength will furnish adequate test signal for alignment of the intermediate frequency amplifier, using the quartz filter for establishing the proper IF frequency as indicated in the following procedure.

The meter on the RME-69 receiver affords an excellent method of indicating the peak alignment of each of the transformers. The location of the three intermediate frequency amplifier transformers, T_3, T_4, and T_5 is given on Figure 4A of the illustrated sheet attached. The two padding condensers located in each of these transformers, and accessible through apertures in the top of the shields, can also be seen.

I.F. AMPLIFIER ADJUSTMENT

The intermediate frequency amplifiers in the RME-69 Receiver are designed for a frequency of 465 Kc. Since these receivers are always supplied with a quartz crystal filter, it is essential that the intermediate frequency amplifier transformers be accurately aligned with the crystal frequency. Crystals are suppled in frequencies

slightly at variance from the above stated value of intermediate frequency by an amount not greater than one kilocycle ±465 KC. Rather therefore than align the intermediate frequency amplifier stages of the RME-69 to a set frequency of 465, it is essential that the alignment be done in conjunction with the quartz filter so that alignment of the intermediate frequency amplifier is achieved at the frequency of the filter. This is done as follows, and when the process as herein outlined is followed accurately, maximum results will be obtained. The use of any other process of a general type will produce inferior results.

The first step in the alignment procedure is to tune in a broadcast station, preferably in the low frequency portion of the broadcast band. The signal should be one of medium signal strength so that the R meter indicates a signal level of R9 or slightly less. If no station of this amplitude is available but a stronger station is available, a reduction in the efficiency of the antenna by the connection of a short wire to the antenna post may help to bring the signal strength as indicated down to R9. Usually between 550 and 800 KC in most any territory, a station can be received at most any time for this test and adjustment.

When the station has been chosen, let us assume that its frequency is 700 KC, the next step is to slightly detune the main tuning control so that the frequency reads approximately 715 or 720 KC. This of course will tune the station out. It does not necessarily have to be the frequency mentioned or the exact frequency of detune, but the general procedure is to tune the main tuning control slightly higher than the chosen station so that it may be brought back to resonance by decreasing the scale reading on the band spread control. This is done merely to provide vernier tuning.

With the station chosen and resonated on the band spread scale, the crystal filter is switched to the series position which is the middle position of the three available, or, in the case of receivers having the revised crystal circuit (Receivers built on or after February 1, 1938) set the phasing control "B"to 50% rotation (pointer vertical upwards). The band spread scale is then adjusted with respect to the signal so that a maximum meter reading is obtained. This procedure is one which requires patience and accuracy of adjustment since the receiver is ultra sharp with the crystal filter in and there will be one definitely sharp peak indicating crystal resonance. The receiver should be tuned to this peak and left on it during all adjustments to be regarding the intermediate frequency amplifier.

When this peak has been tuned to and the meter is at maximum reading, a small standard intermediate frequency trimmer tool of the insulated screw-driver type should be used. Then the control "E", Figure 2A, should be set so that the condenser it adjusts is set at 50% mesh. Then, without particular attention to a course of procedure in tuning, any transformer may be adjusted at any particular time, the important factor being that they all be adjusted so that the R meter is brought to and left at a maximum meter reading. Usually this adjustment will not require very much turning of the adjustment screws. A good procedure to follow is to start with the #1 transformer and align in sequence #2 and #3. All adjustments should be made as before mentioned so that the meter reading is maximum.

It is advisable from time to time to make sure that the signal is still adjusted to peak resonance of the crystal by slightly varying the adjustment of the band-spread control. When this procedure has been completed as outlined and all transformers have been adjusted and left at maximum meter reading, the intermediate frequency amplifier of the receiver is in peak adjustment and the crystal aligned with it for maximum effectiveness in filter action.

RME-69 INTERMEDIATE FREQUENCY AMPLIFIER ADJUSTMENT WITH SILENCER INSTALLED

The general procedure for alignment of the intermediate frequency amplifier as described above also applies to receiver in which the LS-1 silencer has been installed. Preliminary adjustment as above described should be made with the silencer threshold control set at maximum clockwise position, of rotation. When the I.F. transformers have been aligned as outlined, the silencer transformer may be peaked by turning the band

switch to #6 band on the receiver and tuning in and resonating the frequency band around 30 megacycles so that the receiver is sensitive at that point. Then under conditions of automobile ignition interference the silencer control should be set to maximum counterclockwise rotation position and the small screw, accessible through the hole in the noise rectifier transformer located on the silencer auxiliary chassis, should be adjusted for a minimum response of the interference noise. This insures accurate alignment of the noise amplifying system with that of the intermediate frequency, a condition which must ncessarily exist for efficient silencer action.

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The following instructions are for adjustment of crystal phasing in the crystal filter circuit of receivers built prior to February 1, 1938:

After the intermediate frequency amplifier has been aligned as per the instructions under the article concerning I.F. transformer alignment, a check of the phasing of the crystal filter should be made. Tune in a broadcast station, preferraby on the low frequency end of Band 1. Then tune the main tuning control slightly to the high frequency side of it, say 10 KC or more higher in frequency than the selected station. Then resonate the station again by means of the band spread control. Next set the crystal switch to the series position (Position"S"). Now vary the band spread control as may be required to produce peak reading of the signal on the R meter by resonating with the crystal resonance peak.

With this setting achieved, vary the dial Number 1 slightly higher and slightly lower by 5 kilocycles as can be approximated by calibration of the dial (one-half division each way, since one division is representative of 10 KC.) and notice the drop in the R meter reading. The drop so achieved by varying the setting of Dial 1 five kilocycles above and below the selected signal should be productive of an R meter drop of 40 db. or greater. In other words, if the signal when resonated produces an R meter reading of 60 db. on the R meter scale, setting the dial Number 1 five kilocycles higher in frequency than the frequency of the signal being used should make the R meter fall to 20 db. or less. Similarly, setting the dial Number 1 five kilocycles lower in frequency than the station used, the R meter should again fall from 60 db. on the scale to 20 db. or less. Should it fail to do this, the phasing condenser (C_1, Fig. 4A) should be adjusted and a test made as just described by 5 kilocycle above and below adjustment of Dial 1 until the proper variation in the R meter is achieved.

It will be found that the condenser C_1 will usually run at a very low value of capacity, very close to its minimum capacity adjustment. Therefore only slight turning of this condenser will be productive of changes which materially affect the attenuation of the crystal filter. It is usually found that this condenser is not required to be adjusted since it holds its setting very well over long periods of time. The procedure just outlined gives the proper method for checking the phasing and adjusting when necessary.

ALIGNMENT OF RADIO FREQUENCY SECTION OF THE RME-69 RECEIVER

Alignment of the radio frequency section of the receiver will affect principally the calibration of the receiver. Within certain limits this of course will also affect the sensitivity. A small variation in frequency (up to 2%) will not materially reduce the sensitivity of the receiver although they of course will show up as variations in the calibration as indicated by the required setting of the main tuning dial indicator. Correction for any variation in calibration can be made by following the suggestions outlined below.

Band 1 includes the frequencies between 550 and 1500 KC. For band one there are two frequency adjustments for adjusting the indicator to proper calibration. One of these, C_s, is adjusted as indicated on Figure 4A through the top of the shield can just in the rear of the main tuning condenser assembly. Just in front of this aperture and on the main tuning condenser assembly is C_t which is used to adjust the

frequency for the high frequency end of Band 1. The procedure for this: Put the main tuning indicator to a position so that the main tuning condensers are fully m shed. The pointer of the main tuning control should then be set at maximum left end of scale so that the pointer falls just below the line above the numbers indicating the various channels. In this respect it will partially cover the top half of the numerals indicating the different tuning bands on this scale. In other words, the line which borders the semi-circular scale at the extreme counter-clockwise position should rest on the top edge of the pointer as it is turned to maximum counter-clockwise rotation and the condenser plates are at full mesh.

The next step is to choose a station or a signal of accurately known frequency, around 700 KC, and set the main indicator to the frequency of the signal which is going to be used for the test. For example: There is a station available with i fairly good signal strength or a test oscillator is available which can ACCURATELY be set at 700 KC. If the receiver indicator on the main tuning dial is set at 700, and the receiver is considerably out of calibration of course the signal will not be received. However, leave the indicator at the correct frequency of the signal being used for the test and set the band-spread control to a reading of 180 on the dial at which position it has no material effect on the tuning circuits of the receiver and permits the calibration of the main tuning dial to indicate accurately the frequency of setting.

Then by means of condenser C_s (Figure 4A) accessible through the trimming hole in the oscillator shield can for Band 1, adjust until the signal is brought in with the pointer set at the proper frequency. Then choose a signal at about 1200 or 1300 kilocycles, and set the main tuning dial indicator to the correct frequency for that signal and bring the signal in on that setting with trimmer C_t. It will then be necessary to return to the former frequency setting of 700 KC to make sure that the variation of C_s has not made some slight change in the setting for the lower frequency calibration point and it may be necessary to readjust C slightly again. Then in order to make certain of the accuracy of both settings return to the frequency chosen between 1200 and 1300 KC and if necessary, slightly readjust C_t again. After several checks on each frequency it will be found that the calibration can be made satisfactorily.

Calibrations on the higher frequency bands are controlled for Bands 2,3,4,5 and 6 by the trimmers C_r, C_q, C_p, C_o, C_n, (Figure 11B) respectively. High side beat is used on all frequencies in the RME-69 Receiver which means that all of the condensers C_r, C_q, C_p, C_o, C_n, must be set to the lowest capacity setting which will provide a beat and the proper calibration for the frequencies in the respective bands. Calibration frequencies used are as follows:

Band 2: 2 megacycles and 3 megacycles
Band 3: 4 megacycles, 5 megacycles, 6 megacycles
Band 4: 7 megacycles, 9 megacycles, 11 megacycles, 13 megacycles
Band 5: 14 megacycles, 15 megacycles, 17 megacycles
Band 6: 30 megacycles

After the calibration has been made accurately on all of the frequencies, or if the receiver has been found to be accurately set insofar as its calibration is concerned on all frequencies, the trimmers C_b and C_a have a distinct effect upon the RF grid circuits for bands 5 and 6 respectively. They are adjusted as follows: With a steady incoming signal on between 14 and 15 megacycles and the most effective setting of the control "D" for signal in that region, and with the antenna connected, the condenser C_b is adjusted for maximum meter reading. With these same conditions existing on 30 megacycles, with the band switch not on Band 6 and the antenna connected, C_a is adjusted for maximum response on a given steady signal. All other trimming and adjusting is done manually by means of control "D", Figure 2A, and is a variable RF amplifier and detector grid padder which can be critically adjusted for peak resonance at any frequency it is desired to tune to.

It is of importance to note the setting of the condenser C_c (Figure 4A). This is the antenna coupling condenser used when the receiver is ~~set to Band 1~~. It, as well as condencer "C" (Figure 4A), should be set to practically its minimum capacity in order to provide constant alignment and proper coupling to the antenna when using Band 1. Excessive capacity in the condenser C_c will cause misalignment of the RF amplifier and hence promiscuous beating of harmonically related broadcast frequencies to the effect that a number of whistling tones will be received on the high frequency end of the broadcast band. When the receiver leaves the factory it is set at a very small capacity and should not be set at any other capacity or material reduction in the efficiency of operation will be produced.

Whenever the receiver is gone over for alignment, it is well re remove the dust cover from the condenser assembly and inspect the permanence of position of the rotor plates of the ganged condenser controlled by the knob "D". This is located between the two main variable condensers and is located underneath the dust cover which is removable by unscrewing the four acorn nuts holding it down on the condenser assembly. Some times the rotors become loosened and misplaced angularly with respect to each other. They should always be adjusted so that the rotors are at full mesh at the same time. Any slight angular displacement of one rotor with respect to the other will materially reduce the sensitivity of the receiver and destroy the preselection, thereby reducing the image frequency rejection and also the sensitivity, especially on the high frequency bands.

The padders C_b and C_a (Figure 11B) materially contribute to the image signal rejection on the bands 5 and 6. Special care should therefore be taken in the adjustment of these condensers when the receiver is aligned.

ADJUSTMENT OF THE BEAT OSCILLATOR

The beat oscillator has its frequency adjustable on the panel by means of control "C", Figure 2A. This control is normally set for zero beat with the condenser C_u set at 50% mesh. If it is found that zero beat does not occur or that the beat oscillator is not beating with the intermediate frequency to produce an audible solid beat, it is probably due to the fact that the beat oscillator is tuning to a frequency other than the intermediate frequency of the receiver. This can be remedied by the following procedure:

Set the Band Switch to position #1, and tune in a broadcast station so that it reads maximum on the R meter. With this condition existing, snap on the beat oscillator (Switch "I" Figure 2A), or in the case of a receiver with built-in noise suppressor the switch "I" is at the left under the headphone jack (See Figures 2A and 2B). Then by making certain that the condenser C_u is set to 50% mesh, the condenser C_v on the diagrams (Figure 16 and Figure 4A) and located in the beat oscillator compartment just below C_u (Figure 4A) near the top plate of the chassis in front of the beat oscillator tube should be adjusted by means of a screw-driver so that zero beat is achieved with the signal tuned in as before mentioned. When this is achieved, variation of the beat oscillator from inimum to maximum mesh will give a total beat frequency variation of 8 kilocycles (± 4 kilocycles from zero beat).

NOISE: ITS CAUSES AND A METHOD OF ELIMINATION

Noisy operation of a receiver can be caused by several things. Principal among these are loose elements in a vacuum tube, poor seating of the tube in its respective socket, and a loose or broken connection in the circuit wiring of the receiver, or the abnormal position of two circuit components which should be normally isolated from each other but due to some cause or other have become bent into such a position as to occasionally contact and change the circuit conditions to an extent which produces over-all receiver noise.

The first trouble of course has an obvious remedy in the replacing of the tubes. The second also has a simple remedy of making certain that the tubes are well seated in their sockets, and this can be done by removing the tube shield caps and pressing firmly on the bulb until the tube comes to a stop with the base directly against the socket material.

The third condition can be checked by examination and observation. If the connection which is poor is in a DC circuit it will usually cause a variation in the DC voltages as can be measured by a meter and checked with the values herein given for the proper voltages at the various points in the radio frequency and power circuits of the receiver. If the effect is not such as to produce a change in the DC voltages, the trouble will be more difficult to find, but an outline is given below for a simple procedure which will save time and be very thorough in method so that many intermittent troubles can be located easily and quickly.

The fourth cause of the trouble can be located in the same fashion as suggested for the intermittent contact since it in itself is of that type of trouble. Before any investigation of the receiver itself is made, the antenna connections to the receiver must be removed in order to insure that they are not causing the trouble by allowing outside interference to be picked up.

When the antenna leads have been disconnected so that it is made certain that the noise, if it still continues, is not being caused by any variation in the antenna circuit, a general procedure can be carried out which will isolate all four of the types of noise described above and localize the source to a point where it will be much easier to work on due to the fact that the observations and investigations can be concentrated in a small portion of the circuit.

METHOD:

Resonate the receiver so that it is all adjusted to peak tune as will be evidenced by the receiver noise itself. Then remove all of the tube shield caps from the radio frequency amplifier, the detector, the two I.F. amplifier tubes, and the 6B7 tube. Then by means of a padded tool of some kind--a rubber stick, or something which will not in itself make noise upon contact with the metal parts of the receiver--the receiver should be gently tapped in various parts in order to determine whether or not tapping on certain parts of it will cause the noise to occur more readily than on others. This will also give an idea as to the localization of the source of the noise. The tapping should be continued in this place found to be most effective in the production of the noise by carrying on the following succession of tests:

Take a .1 μfd. paper by-pass condenser with good clean leads on it, and solder one lead to the ground or clip it to the ground of the chassis of the receiver. Then, continuing the tapping of the place found to be most productive of the noise, connect the other side of the .1 condenser first to the grid cap of the first radio frequency amplifier, then to the grid cap of the first detector, then the first IF, then the second IF, etc., until the noise is stopped. When it is placed on a grid cap which suddenly stops the noise, it is indicative of the fact that the noise is caused by the stage just ahead of the tube which when shorted stops the noise. For instance, there is a loose connection in the plate circuit of the first radio frequency amplifier tube, and it is found that by tapping the receiver on the main condenser cover the noise is readily produced and continued. By continued tapping of this part of the receiver (Even with several of the fingers of the hand) the first grid is bypassed to ground by means of a .1 μfd. condenser. However, the noise continues. This indicates that the noise is probably not being caused in the grid circuits of the radio frequency amplifier tube. The condenser free lead is then connected to the grid cap of the first detector tube in which position the noise stops, indicating that the trouble is undoubtedly caused just preceding the grid of the radio frequency amplifier tube since by-passing the grid of the radio frequency amplifier tube to ground did not stop the noise.

Another condition may be also caused by the fact that by by-passing the grid of the detector tube and the radio frequency tube the noise was not stopped, but it did stop when the by-pass was applied to the grid of the first intermediate frequency amplifier. This indicates that the difficulty is just preceding the first intermediate frequency amplifier. However, it does not necessarily mean that the loose connection or the trouble is in the first detector tube, since it might be caused by a variation of contact in some part of the oscillator tube. Therefore the oscillator tube shield

cover should be removed, and the by-pass lead applied to the grid of the heterodyne oscillator between the filter pack and the broadcast band oscillator coil just at the rear of the main tuning condenser assembly, and if this stops the trouble, it is likely that the noise is being caused in the oscillator circuit. However, in any case, the noise will be localized in the oscillator and first detector circuits. This same thing can apply to any part of the receiver. It is merely mentioned here to describe the principle involved which is merely a process of eliminating various parts of the circuit until the noise is eliminated, and if it is done step by step the various steps can be accounted for as either being free of the cause or as causing the noise in themselves.

In this connection, it might also be well to say here that oftentimes such noise is caused by variable contact between tools on the bench lying near the receiver, especially if a sheet metal ground plate is used on which to test the instrument. It will also be found that a screw-driver or pair of pliers lying on a metal ground plate on top of a test bench will, when the table is jarred, cause a variable contact and hence a "staticky" effect in the receiver. Therefore it should be made certain that the "staticky" effect or the variable or intermittent noise source is not vested in tools or loose wires which make variable contact with ground potential plates or leads when this work is being carried on.

RECEIVER INOPERATIVE

Of course, the first thing to do in case of an inoperative receiver is to check the voltages as given in the list in this instruction booklet.

Another short check which can be given immediately upon finding the receiver dea is to remove the shield cover from the 6B7 tube and without touching any metal part with the body, apply a finger to the grid cap. It should be made certain that when this is done the volume control "H" (Figure 2A) should be turned to the maximum clockwise position so that the audio level is adjusted for maximum output. A squealing tone should be received, or, at least, a loud hum showing that the audio system is not at fault. This will indicate that the difficulty lies ahead of the audio system, and routine test oscillator checks can be made on each stage by applying the output of the oscillator to the grid caps and noting the results on the level meter of the receiver. IMPORTANT: In order to prevent shorting out the AVC system when connecting the test oscillator output leads to the various tube grids, insert a .1 μfd condenser in series with the connection to be placed on the grids for test purposes.

If accurate signal generators are had for the testing of these receivers, the following gains can be measured for test purposes: (Meter should be adjusted to zero with no signal and antenna should be disconnected.) 100,000 microvolts (or .1 volts) fed to the grid of the second intermediate frequency amplifier grid should produce a reading of R7 on the R meter. An R7 reading on the meter should be produced by applying 2,000 microvolts to the grid of the first intermediate frequency amplifier as just described.

With the band switch set to Band 1 and the main dial set to 1,000 kilocycles or one megacycle on the main tuning scale, and input of 30 to 40 microvolts at 465 KC to the grid of the first detector tube should be productive of a meter reading of R9. All these readings are subject to a variation of ±5%. These readings are given only for use when service work is carried on by means of an accurately attenuated signal generator which can be used to give a calibrated output. Since most service generators are not calibrated, this material cannot be used with them.

Signal generators such as the laboratory type General Radio Signal Generator and the Ferris Microvolter, which are accurately calibrated to deliver outputs in known values of voltage, can be used to advantage in quickly determining the alignment of these receivers.

If the receiver is dead, and the R meter does not fall to zero it is indicative of a loss of load on the B supply to the intermediate frequency and radio frequency

amplifiers. A defective tube which loses its heater continuity, in other words, which burns out, or a tube which loses its emission, will reduce the load on the meter bridge circuit so that the meter will not return to zero but will read up on the scale. An open plate or an open screen on any of the tubes will be productive of the same difficulty as evidenced by the high scale meter reading. A tube which has become loosened in its socket so that its contacts do not make proper continuity with the socket connections, principally the plate, cathode, and screen connection, will also sometimes open up the plate, screen, or cathode circuit to the extent that the total load on the bridge circuit will be reduced, and any reduction in the total plate current drawn by the amplifier tubes will of course cause the R meter to read up on the scale. In a condition which causes the R meter to read up on the scale an which can not be compensated for by normal adjustment of the carrier level meter control on the rear of the receiver chassis, it is probably due to a loss of circuit co tinuity in the RF or IF amplifier stages. Checking of the cathode voltage, screen voltage, and plate voltage at the tube socket connections on each of the stages will probably determine which tube is at fault. A tube which is not drawing current will show plate and screen voltage probably but will show either "no cathode voltage" or if the external cathode circuit is open, it will show an extremely high cathode voltage. Proper values of these voltages are given in the table appended to this service booklet.

CONDITIONS INDICATING LOSS OF AUTOMATIC VOLUME CONTROL

The principal result of loss of automatic volume control will be the garbled output of the overloaded blocking condition caused on strong signals when they are tuned to exact frequency. Loss of automatic volume control can be caused by either a ground anywhere on the automatic volume control system or maladjustment of the 2nd IF amplifier output transformer T5. Since proper adjustment of this transformer T5 is neces ary in order to provide the diode elements of the 6B7 tube with full driving energy in order to produce the maximum intensity of automatic volume control voltage, it is necessary that it be properly aligned. If all the other stages are aligned, delivering normal grid voltage to the 2nd intermediate amplifier tube and T is misaligned to a point where it does not provide adequate automatic volume control voltage, the overloading-blocking condition which causes the audio output to become badly garbled will be noticed. Similarly, as before mentioned, any ground on the automatic volume control supply circuit will probably cause overloading on strong signals. Even a resistance of 250,000 ohms caused by leakage to ground will destroy full AVC action. This same effect can be noticed by turning the manual gain control to a point where the switch controlled by it just snaps on, shorting out the automatic volume control. In this position, the amplifiers do not have sufficient grid bias to prevent grid current flowing in the last intermediate frequency amplifier and the same effect will be noticed.

It will be necessary, of course, to continue rotation of the manual gain control to raise the bias to a point where the signal input to the later stages of the amplifier is not excessive and will not cause rectification or grid current to flow in the respective grid circuits of these tubes.

Distorted output can also be caused by a defective 6B7 tube or a 42 amplifier tube. Loss of bias on the 42 tube will of course produce excessive distortion. A continued predominate muffled bass output may be indicative that the tone control which is connected between the grid of the 42 tube and ground is defective to the extent that the resistance is at all times zero, connecting the tone control condenser directly from grid to ground. The tone control resistance R24 is a potentiometer type resistor having a total resistance of one million ohms. When set so that it provides a one million ohm resistor in series with a .01 condenser across the grid to ground of the 42 tube, it has little effect on the audio characteristic of the receiver. When set so that this resistance is zero and in effect the .01 condenser is connected directly between the 42 grid and ground, the receiver audio characteristic is cut off rather abruptly around between 1,000 and 2,000 cycles.

HUM

Hum can be classified in two groups: One type of hum is that which is caused by the filter of the receiver and is applied to the tube circuits in such a way that it is reproduced continuously regardless of signal or whether there is any output to the receiver or not. This type of hum is almost always due to a defective filter condenser and can be remedied of course by replacing the filter block or at least shunting the defective section with a good condenser.

There is another type of hum which appears only with signal. This type of hum can be caused by two things: The most common source is a poor ground. A ground in which considerable alternating current from the supply mains is circulating and which is by some non-linear characteristic of the ground system modulating the radio frequency circulating in that ground will actually modulate the carrier before it is impressed on the receiver.

The other source is a defective tube. Either one of these two hums are noticed only with signal.

NOISE CAUSED BY FAULTY VARIABLE CONDENSER

The several variable resistors in the receiver can with age cause some noise during rotation. The remedy for this of course is the replacement of the control. All controls of this type, depending upon the design, have a certain life as does any type of rotating equipment. In the rotation of control "H" (See Fig. 2A) one other factor may enter in with age to cause noise during rotation of the shaft. This noise may not be due to the rotation of the resistor itself, but due to some slight eccentricity in the control shaft which produces a variable contact on the jack switch. The contacts of the jack switch should be closed when the control "H" is in toward the panel, and they should be open when pulled outward from the panel. There is one exception to this and that is in a receiver with a special jack switch for the operation of an external relay. In this case, there will be one center contact on the switch which is connected to the grounding bladeof the switch when the rod is pulled out. These conditions can be guaranteed by observation of the switch and adjustment of the blades by means of pliers and screw drivers so that they operate as described.

FREQUENCY INSTABILITY

Frequency instability dan be caused by a number of factors. Principal among these factors is the oscillator tube itself. Excessive drift or rapid fluctuation due to vibration can be caused by the oscillator tube itself. Replacement with a satisfactory tube will remedy the situation. Another cause of instability can be tight bearings on, principally, the main tuning condenser. If these bearings are so tight that during normal heating of the instrument, causing expansion of the metal parts, the shaft is warped, it will cause excessive frequency drift. The normal frequency drift of the receiver in the first 30 minutes of warming up is between 8 and 10 kilocycles at 15 megacycles. At lower frequencies it is proportionately less and at higher frequencies the drift is proportionately greater. Values greatly in excess of this are not normal and are caused by either poor grounding contacts on the coil assembly and the coil shield and coil switch assembly underneath the chassis or a defective oscillator tube, a defective oscillator grid coupling (C_{33}, Fig. 4A) which is a small mica condenser mounted on the bakelite terminal strip on the end of the main tuning condenser. Correction for the main tuning condenser tension as a cause of the frequency drift can be reduced by releasing the tension on the rear bearing of the main tuning condenser so that the condenser has freedom of rotation, not to the pointer, however, which will allow it any end play whatsoever, since this will be productive of very erratic tuning.

This same tightness in the bearings of the condenser can also cause backlash in that it will produce an excessive load on the spring loaded gears of the dial drive and give an apparent "rubbery" action at the knob. A poor contact in the oscillator section of the band switch or in the band circuit wiring will also be productive of frequency drift, usually of the rapid type which will produce a wavering of the sig-

nal to the point of a flutter. The effect of the band switch on calibration can be checked by rapidly switching the band switch from one band to another, having on one band tuned in a station. It should always be possible to return the band switch to that band and have the station remain in tune.

If changing the band switch away from the particular band being used and then putting it back again into the same position causes a shift in frequency, it is probably due to the switch contacts themselves and can be improved upon by increasing the pressure of the collector ring which presses the small contactor lug up against the fingers of the switch. The collector ring is on the opposite side of the switch from the fingers which are the contacts on the switch.

MICROPHONICS

Microphonics are usually due to the fact that some element in the receiver is subject to variations in its electrical characteristics when placed in a strong sound field or in a field where there is considerable vibration. This means that if the receiver is responsive to vibrations and jarring by producing a ringing tone when a signal is tuned in or setting up a howl under the same conditions it is more or less microphonic. All receivers are microphonic to a certain degree, depending upon the tightness of the coupling between the speaker and the receiver itself. Oftentimes a defective oscillator tube will be productive of considerable microphoning action. This is evidenced by the fact that the slightest jar when a signal is tuned in, especially on the very high frequencies, will produce a ringing sound which may turn into a continued howl increasing in amplitude as the time increases. It will be found usually that the remedy is to put the speaker at a slight distance from the receiver cabinet itself. This type of difficulty can be reduced to a very low point by changing the oscillator tube.

There is one other element in the receiver which is also subject to a microphonic action, and that is the main tuning condenser. These plates act like small diaphragms when the sound intensity is very large and vibrate causing a shift in the tune of the receiver at an audio frequency. The action is dependent again as before upon the tightness of coupling acoustically between the speaker and the cabinet of the receiver. Usually breaking a stiff physical contact between the cabinet of the speaker and the receiver will reduce the howl and it is almost certain to stop if the sound from the speaker is made to emerge in a direction which will not impinge upon the speaker housing itself. These effects are noticeable more with the crystal in the circuit and the selectivity is very high and also at the high frequencies where the possible frequency variation by varying the position of elements in the receiver is the greatest. Howling will be set up easiest when the tuning is not exact. That is, when the station is not tuned exactly at resonance. Therefore, by not providing positive tuning adjustment on the carrier the howling will be set up quite easily. Experience in accurate tuning is productive of a very minimum of acoustic coupling as evidenced in the form of microphonic howl.

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TEST VOLTAGES OBTAINED AT VARIOUS POINTS IN RECEIVER CIRCUIT RME-69

(Measurements made with voltmeter having internal resistance of 1,000 ohms per volt. Instruments with other internal resistances give entirely different readings.)
NOTE: Line voltage should be 115 volts.

PLACE TEST PRODS BETWEEN	CORRECT VOLTAGE (Switch "H" in toward panel)	CORRECT VOLTAGE (Switch "H" pulled outward fm panel)
Radio frequency amplifier plate and ground.......	240 volts	0 volts
Radio frequency amplifier screen and ground......	100 volts	0 volts
Radio frequency amplifier cathode and ground.....	3.2 volts	0 volts
First detector plates...........................	240 volts	0 volts
First detector screen and ground................	75 volts	0 volts
First detector cathode and ground...............	3.5 volts	0 volts

PLACE TEST PRODS BETWEEN	CORRECT VOLTAGE (Switch "H" in toward panel)	CORRECT VOLTAGE (Switch "H" pulled outward fm panel)
First I.F. amplifier plate and ground.......	250 volts	0 volts
First I.F. amplifier screen and ground......	100 volts	0 volts
First I.F. amplifier cathode and ground.....	3.2 volts	0 volts
(The same voltages apply to the 2nd I.F. tube elements.)		
6B7 plate and ground.......................	115 volts	145 volts
6B7 screen and ground......................	25 volts	35 volts
42 plate and ground........................	214 volts	280 volts
42 screen and ground.......................	248 volts	290 volts
42 cathode and ground......................	16 volts	18 volts
80 rectifier filament and ground...........	258 volts	335 volts
Oscillator plate and ground................	248 volts	0 volts
Oscillator screen and ground...............	115 volts	0 volts
Beat Oscillator screen and ground..........	100 volts	130 volts
Beat Oscillator plate and ground...........	180 volts	210 volts
The voltage across R_{31}.....................	14 volts	0 volts

(These voltages are subject to a fluctuation of ±15% without indication of material difficulties.)

CONTINUITY CHECKS

(Receiver turned off, and no jumper between A-2 and ground on the antenna terminal strip.)

MEASUREMENT MADE BETWEEN	CORRECT RESISTANCE VALUE
A-1 and ground..................................	Infinite, all bands.
A-2 and ground..................................	Infinite, all bands.
RF amplifier grid to ground.....................	1.25 megohms, ±20%
First detector grid to ground...................	Band 1 3.5 ohms Band 2 1.5 ohms Band 3 .8 ohms Band 4 .3 ohms Band 5 Less than .2 ohms Band 6 Less than .2 ohms
First IF grid to ground.........................	1.5 megohms, ±20%
Second IF grid to ground........................	1.25 megohms, ±20%
Oscillator grid to ground.......................	50,000 ohms, ±20%
Beat Oscillator grid to ground..................	100,000 ohms, ±20%
6B7 grid to ground..............................	Should vary from 50,000 to 300,000 ohms between minimum and maximum rotation of the control "H".
Monitor post to ground..........................	0 resistance (Control "H" in.) Infinite resistance (Con. "H" out)
Oscillator section of bandspread condenser and ground..	Band 1 Infinite; Band 2 .8 ohms; Band 3 .5 ohms; Band 4 .2 ohms; Band 5 Less than .2 ohms; Band 6 Less than .2 ohms.
Cathode of 6D6 oscillator to ground............	Band 1 .75 ohms; Band 2 .3 ohms; Band 3 .2 ohms; Bands 4, 5 and 6 less than .2 ohms.

LEGEND OF RESISTORS, CONDENSERS, CHOKES, AND TRANSFORMERS OF RME-69 RECEIVER SCHEMATIC DIAGRAM.

DESIGNATION	SPECIFICATION
C_a and C_b	30 µµfd. adjustable mica padders.
C_c	30 µµfd. mica padder.
C_d	deleted.
C_e	Dual section resonator control, 4 µµfd minimum, 30 µµfd maximum.
C_f, C_g, C_j, C_k, C_l, C_m.	Adjustable trimming condensers in the ~~intermediate~~ frequency transformers.
C_h	25 µµfd midget air padder.
C_i	30 µµfd mica adjustable phasing condenser.
C_n, C_o, C_p, C_r	30 µµfd adjustable padders.
C_q	70 µµfd adjustable padder.
C_s	.0004 mica condenser shunted by 70 µµfd. mica adjustable trimmer.
C_t	Mica trimmer on the oscillator section of the main tuning condenser.
C_u	70 µµfd adjustable mica padder.
C_v	25 µµfd variable air condenser
C_1	.01 µfd 400 volts.
C_2	.01 µfd 400 volts.
C_3	.01 µfd 400 volts.
C_4	.01 µfd 400 volts.
C_5	.01 µfd 400 volts.
C_6	.1 µfd 400 volts.
C_7	.1 µfd 400 volts.
C_8	.1 µfd 400 volts.
C_9	.002 moulded mica condenser.
C_{10}	.01 µfd 400 volts.
C_{11}	.1 µfd 400 volts.
C_{12}	.1 µfd 400 volts.
C_{13}	.1 µfd 400 volts.
C_{14}	1" of shielded braid wrapped around plate lead of second intermediate frequency amplifier tube. Approximate capacity 10 µµfds.
C_{15}	.00025 µµfd.
C_{16}	.01 µfd. 400 volts.
C_{17}	.1 µfd. 400 volts.
C_{19}	.01 µfd 400 volts.
C_{20}	.00025 µfd moulded mica condenser.
C_{21}	20 µfd 25 volt electrolytic.
C_{22}	.01 µfd 400 volts.
C_{23}	12 µfd 450 volt electrolytic.
C_{24}	.0001 moulded mica condenser.
C_{25}	.01 µfd 400 volt electrolytic.
C_{26}	.01 µfd 400 volts.
C_{27}	.0001 µfd moulded mica.
C_{28}	.01 µfd 400 volt.
C_{29}	.00025 moulded ± 5%.
C_{30}	.1 µfd 400 volts.
C_{31}	.01 µfd. 400 volts.
C_{32}	.01 µfd. 400 volts.
C_{33}	.0001 µfd moulded ± 5%.
C_{34}	8 µfd 450 volt electrolytic.
C_{35}	8 µfd 450 volt electrolytic.
C_{37}	.00025 µfd moulded condenser

DESIGNATION	SPECIFICATION
C_{38}	.1 μfd, 400 volts
C_{39}	20 μfd, 25 volt
C_{40}	400 $\mu\mu$fd, moulded mica
S_1, S_2, S_3, S_4,	Band Change Switch
SW_1	115 volt line switch
SW_2	Beat oscillator on and off switch
SW_3	Switch operated by control "H" for connecting monitor circuit and opening B supply to amplifier stage.
SW_4	Crystal switch for series of for paralllel
SW_5	Cut-off switch for removing AVC action (operated in tandem with R)
L_1	Band 6 RF grid coil
L_2	Band 5 RF grid coil
L_3	Band 4 RF grid coil
L_4	Band 3 RF grid coil
L_5	Band 2 RF grid coil
L_6	Band 1 RF grid coil
L_7	Band 6 first detector grid coil
L_8	Band 5 first detector grid coil
L_9	Band 4 first detector grid coil
L_{10}	Band 3 first detector grid coil
L_{11}	Band 2 first detector grid coil
L_{12}	Band 1 first detector grid coil
L_{13}	Band 6 oscillator coil
L_{14}	Band 5 oscillator coil
L_{15}	Band 4 oscillator coil
L_{16}	Band 3 oscillator coil
L_{17}	Band 2 oscillator coil
L_{18}	Band 1 oscillator coil
RFC	16 millhenries
CH_1	30 henries, 100 ma.
CH_2	30 henries, 50 ma.
T_1	Main power transformer
T_2	Audio output transformer to 4,000 ohms and 600 ohms.
T_3	First intermediate frequency amplifier transformer.
T_4	Second intermediate frequency amplifier transformer.
T_5	Third intermediate frequency amplifier transformer.
R_1	200 ohms, 1/2 watt
R_2	20,000 ohms, 1 watt
R_3	30,000 ohms, variable
R_4	5,000 ohms, 1/2 watt
R_5	1 megohm, 1/2 watt
R_6	250,000 ohms, 1/2 watt
R_7	100,000 ohms, 1/2 watt
R_8	2,000 ohms, 1/2 watt
R_9	500 ohms, 1/2 watt ±5%
R_{10}	200 ohms wire wound var. R meter balance
R_{11}	1,000 ohms. 1/2 watt
R_{12}	800 ohms, 1/2 watt
R_{13}	100,000 ohms, 2 watts
R_{14}	2,000 ohms, 1/2 watt
R_{15}	10,000 ohms, 1/2 watt
R_{16}	2,000 ohms, 1/2 watt

LEGEND (Cont.)

DESIGNATION	SPECIFICATION
R_{17}	1 megohm, 1/2 watt
R_{18}	250,000 ohm potentiometer audio level control
R_{19}	1 megohm, 1/2 watt
R_{20}	100,000 ohms, 1/2 watt
R_{21}	50,000 ohms, 1/2 watt
R_{22}	250,000 ohms, 1/2 watt
R_{23}	5,000 ohms, 1/2 watt
R_{24}	1,000,000 ohms potentiometer
R_{25}	410 ohms bleeder section
R_{26}	7200 ohms, bleeder section
R_{27}	6800 ohms, bleeder section
R_{28}	10,000 ohms, 1/2 watt
R_{29}	100,000 ohms, 1/2 watt
R_{30}	100,000 ohms, 1/2 watt
R_{31}	2,000 ohms, 1/2 watt
R_{32}	2,000 ohms, 1/2 watt
R_{33}	50,000 ohms, 1/2 watt
R_{35}	10,000 ohms, 1/2 watt
R_{36}	5,000 ohms, 1/2 watt
R_{37}	1,000 ohms, 1/2 watt
R_{38}	100,000 ohms, 1/2 watt
R_{34}	50,000 ohms, 1/2 watt
J_1	Headphone Jack

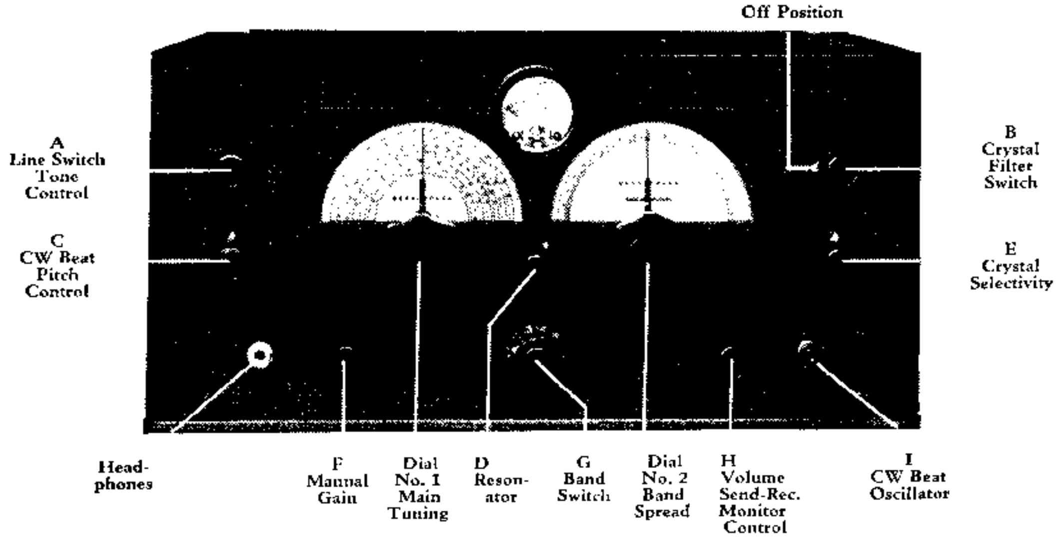


Fig. 2A. Front Panel Layout of the Standard RME-69, AC Model.

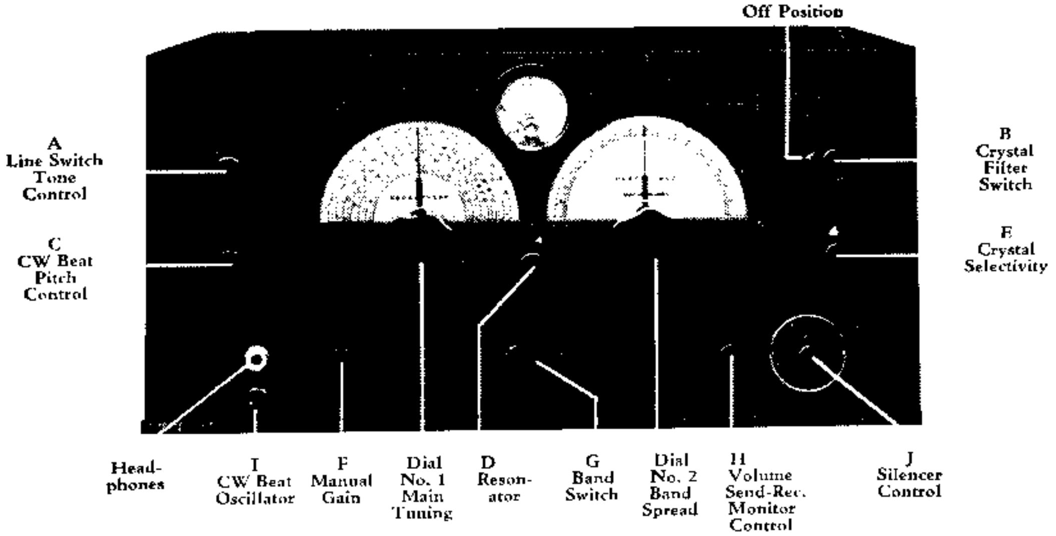


Fig. 2B. Front Panel Layout of the Standard RME-69, AC Model with Built-in Noise Silencer.

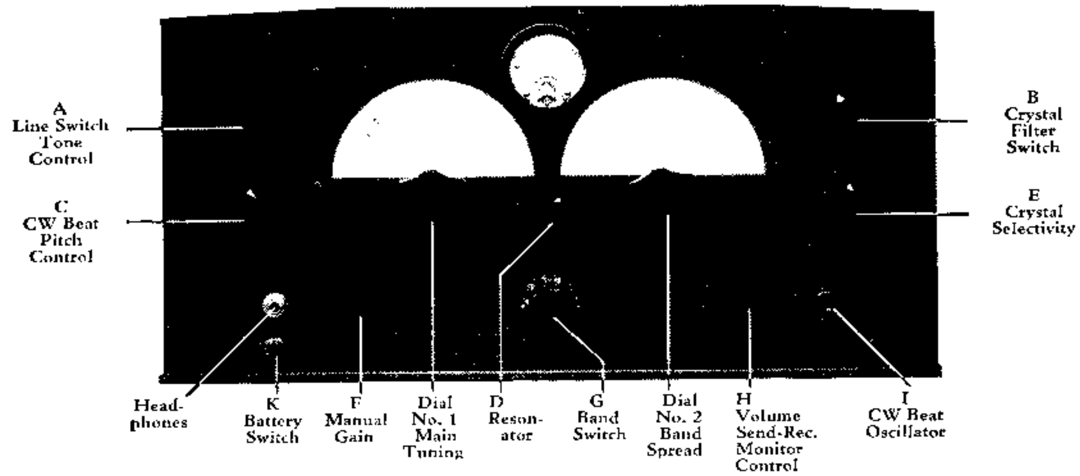


Fig. 2C. Front Panel Layout of the Combination Standard AC and Battery Model RME-69.

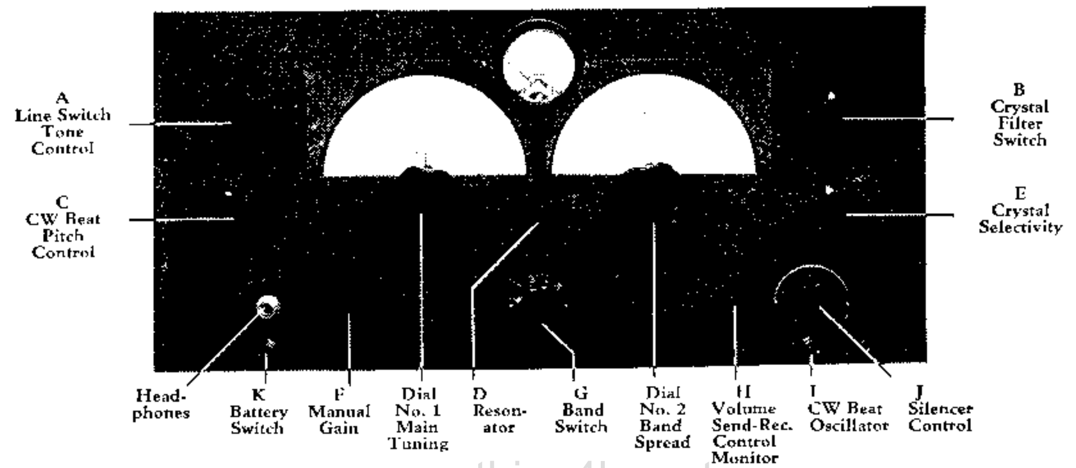


Fig. 2D. Front Panel Layout of the Combination Standard AC and Battery Model RME-69 with Built-in Noise Silencer.

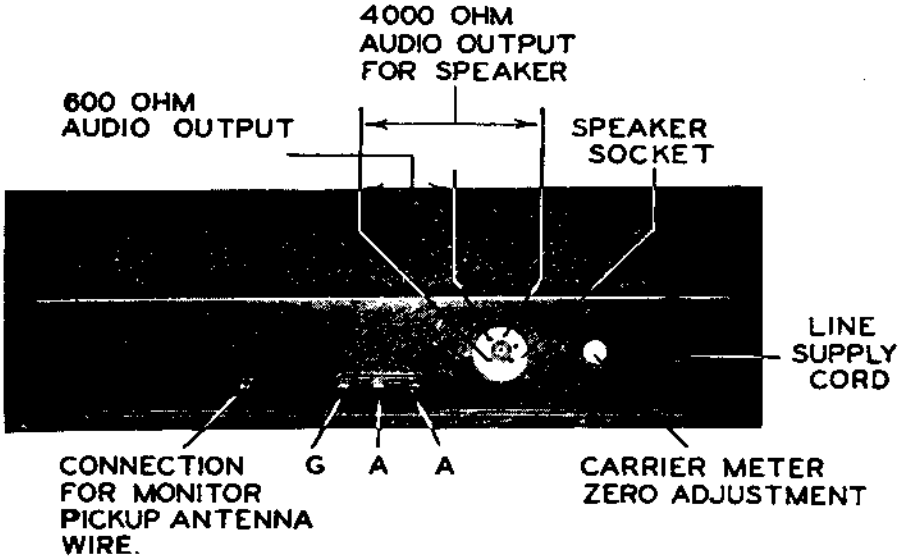


Fig. 3

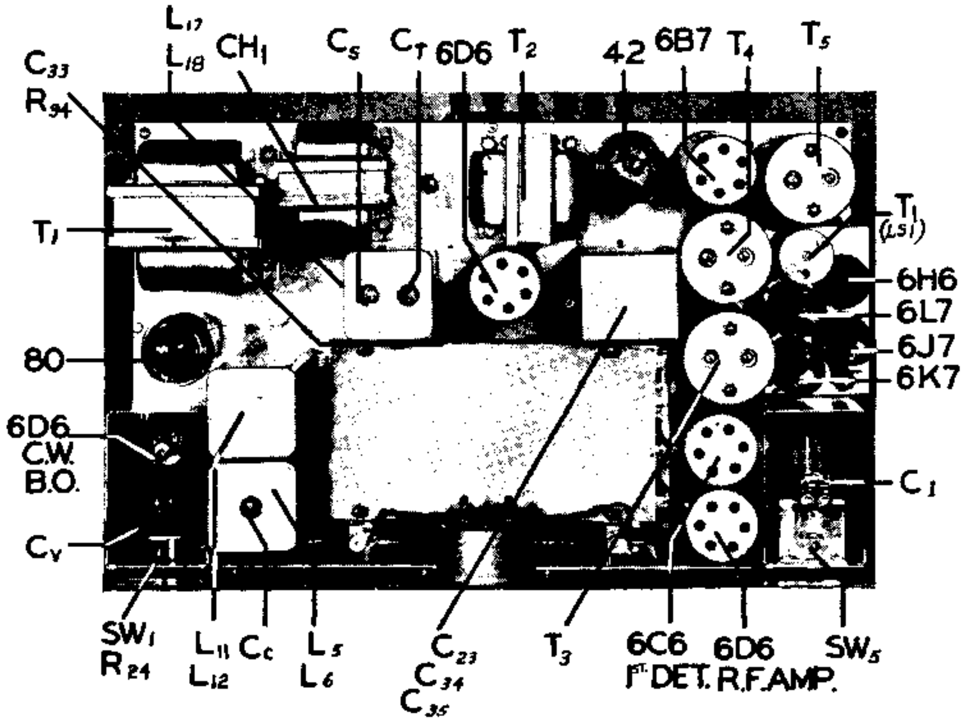


Fig. 4A

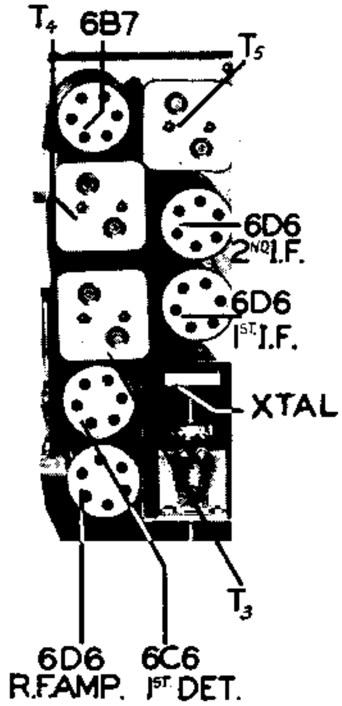


Fig. 4B

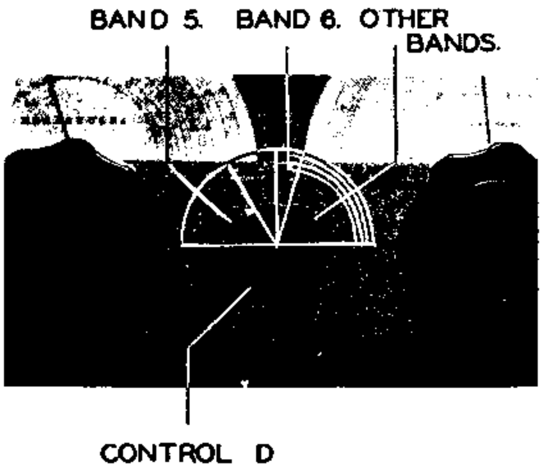


Fig. 5

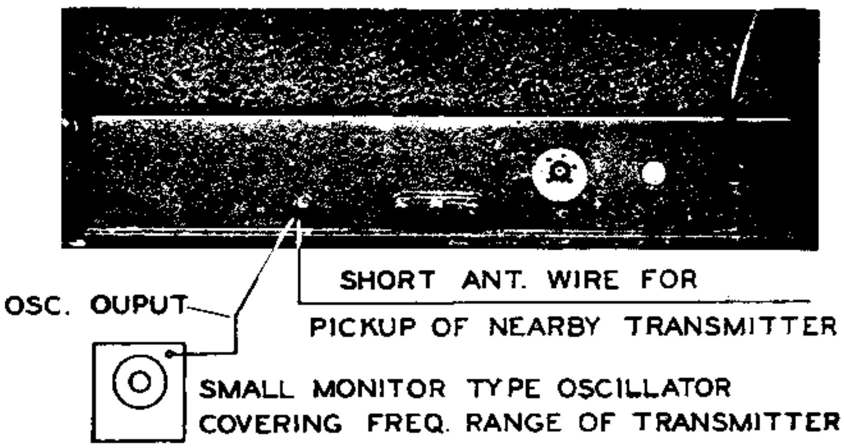


Fig. 6

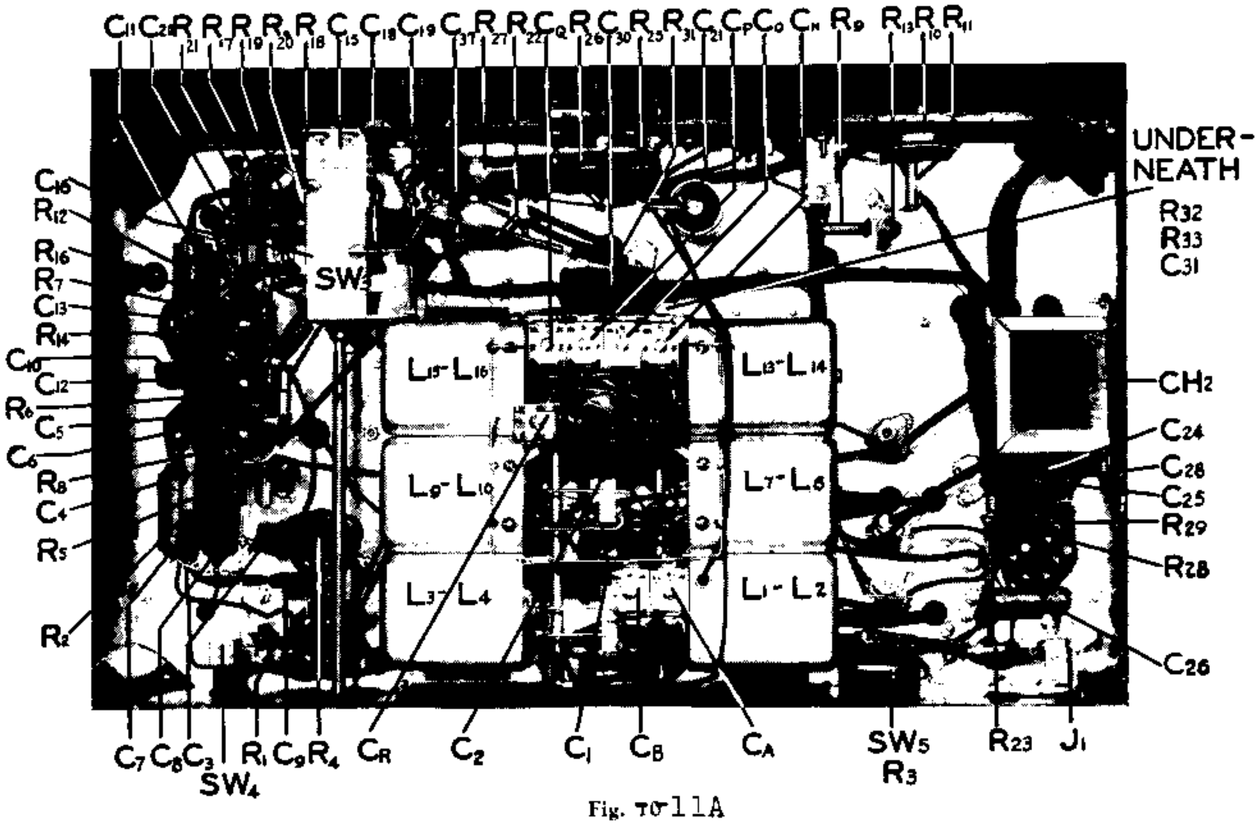


Fig. 7-11A

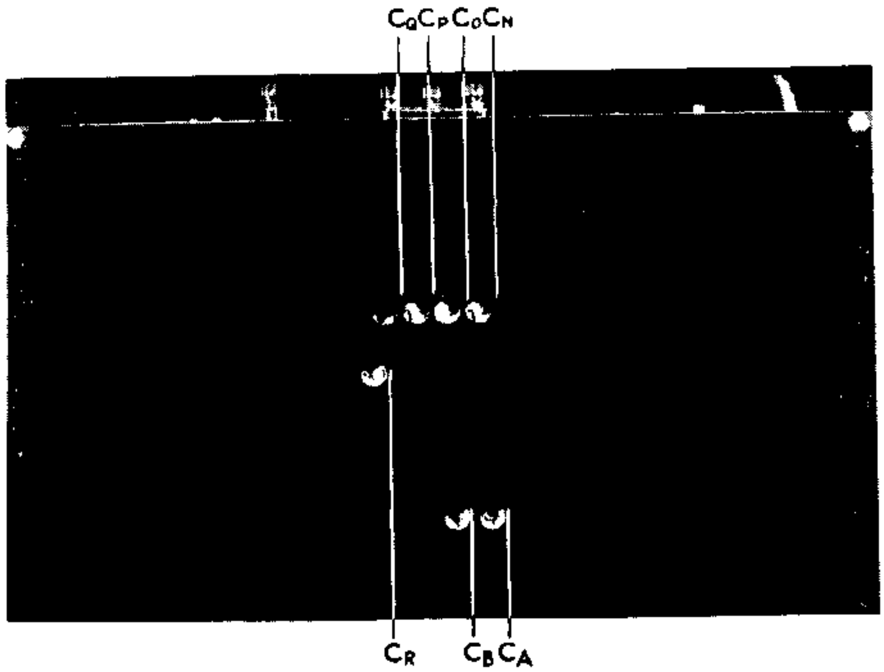


Fig. 11 B

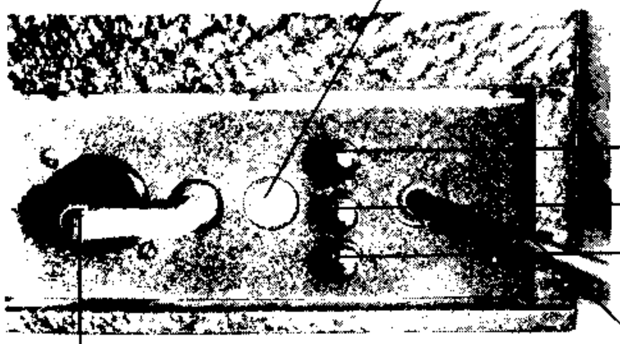


FIG. 7

FIG. 8

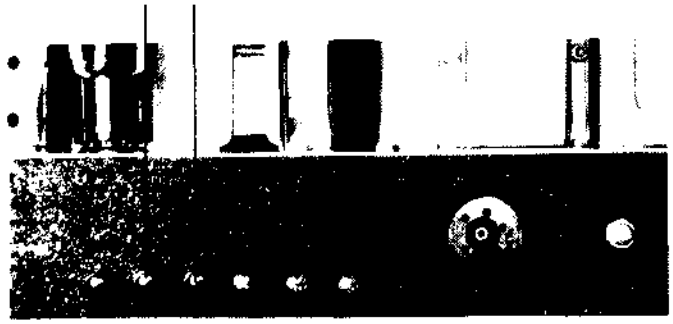


FIG. 9

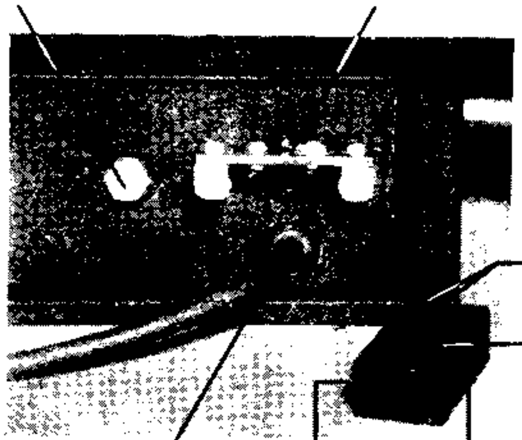
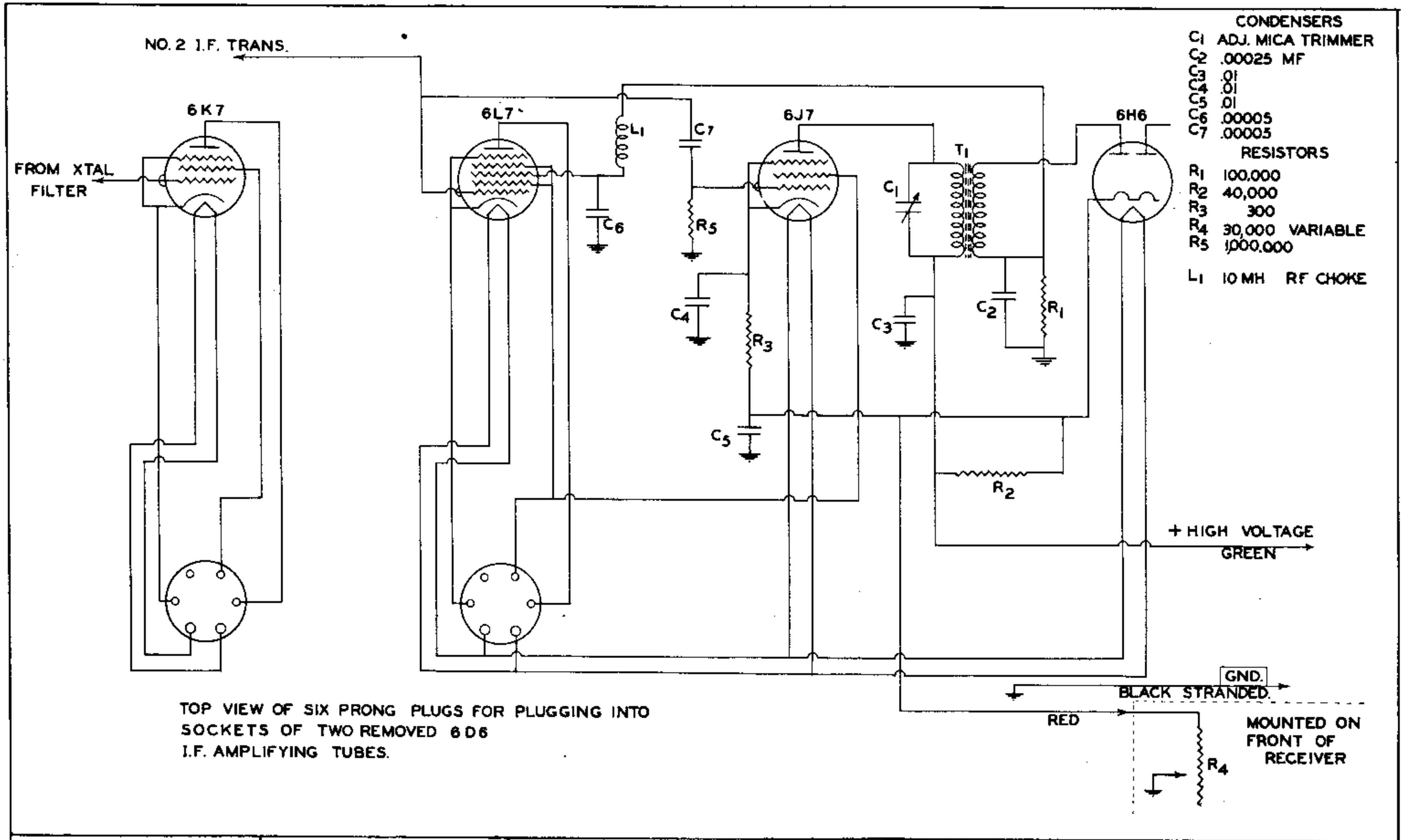
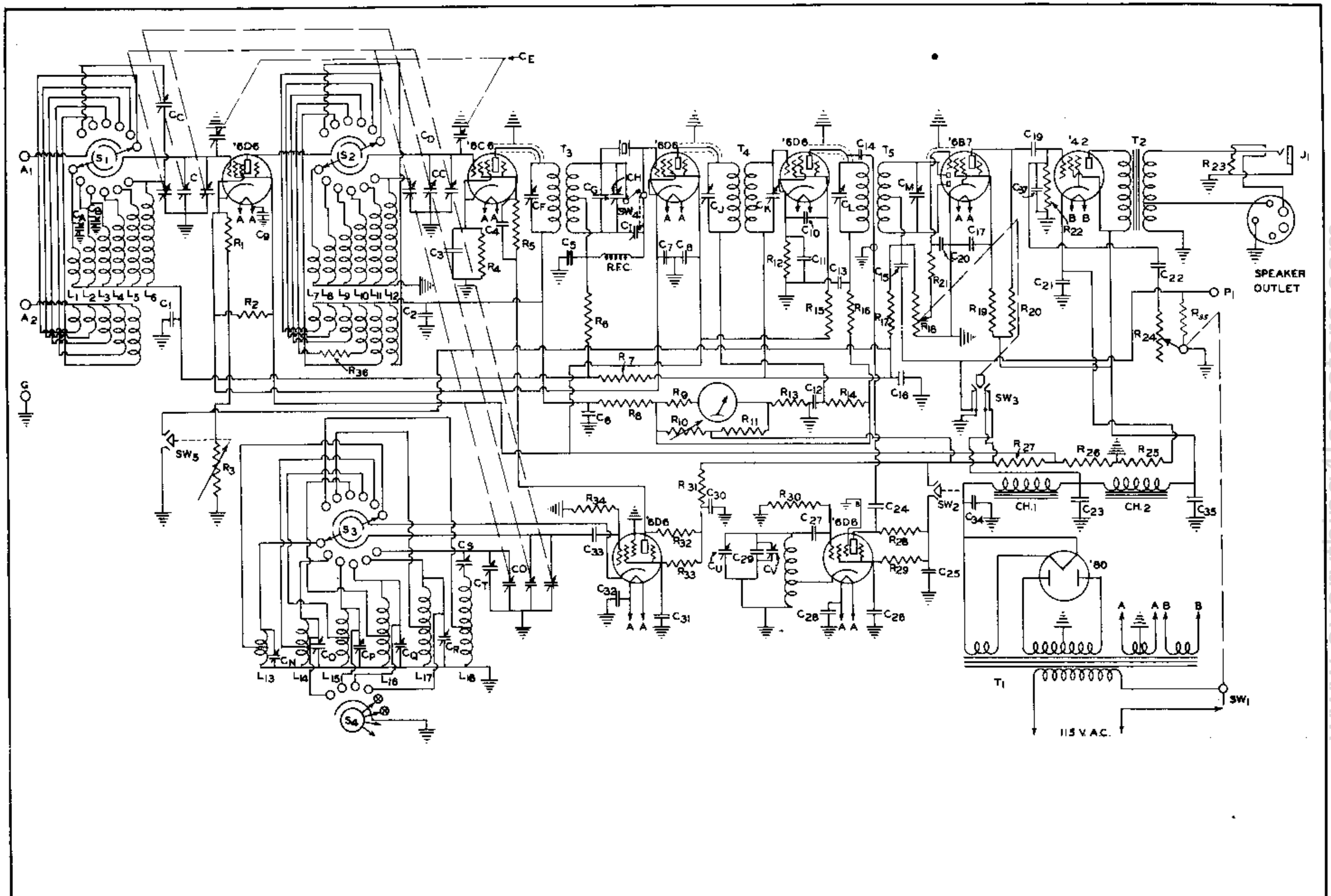


FIG. 10



LS-1 NOISE SUPPRESSOR	B-76			



R.M.E. 69 SCHEMATIC CIRCUIT

C-23